Space Weather Technical Forecast

Issued on Saturday, 30 March 2024 at 12:33 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-flares expected from AR3615 (R1-R2 Blackouts) with chance of X-flares (R3+ Blackouts), easing Day 3 (01 Apr).

Analysis of Space Weather Activity over past 24 hour
Solar Activity: Activity has been Moderate with two M-flares, the largest of which peaked at M1.2 at 29/1934 UTC from AR3615. There are now four sunspot regions on the visible disc, with AR3614 no longer visible but a faint new region developing in the east. AR3615 remains a very large and relatively complex sunspot group. Due to a restricted viewing angle of the group as it approaches the western limb, the previous analysis has been retained, but at least one delta spot remains evident. The other spots are all small and simple unipolar regions.
There have been a number of CMEs observed in coronagraph imagery over the past 24 hours, and analysis is ongoing to determine if there is any potential Earth-directed component.

Solar Wind / Geomagnetic Activity: The solar wind measured by DSCOVR at L1 was indicative of ambient wind conditions, but with hints of an incoming high speed stream in recent hours. Winds speeds varied between 320-380 km/s. Density was average for much of the period, increasing to above average recently, reaching 16ppcc by 30/1200 UTC. Interplanetary Magnetic Field, Bt, was weak but on an increasing trend. The north-south component, Bz, fluctuated weakly. The phi angle was initially variable, but since 29/1230 UTC it has remained positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) remained very slightly above background, but well below the S1/Minor Radiation Storm level. High energy electron flux (greater than 2MeV) observed at GOES16 has been at either background or just touching moderate levels. The associated 24-hour fluence remained below Active, with a value of 6.18e6 integrated pfu at 30/0000UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Moderate at first with further M-class flares expected, and a chance of isolated X-class flares from AR3615. This region is expected to depart the disc late Day 1 (30 Mar) with flare risks reducing significantly. However, any notable Strong flares may remain observable into Day 3 (01 Apr).

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs expected during the forecast period. The current slow wind conditions are expected to slowly increase later Day 1 into Day 2 (30-31 Mar) due to the arrival of a fast wind associated with CH15/+ or CH13/+. Wind speeds are likely to ease later in the period.
Geomagnetic activity is expected to be mainly Quiet, but with the chance of Unsettled intervals Days 1-2, perhaps with an isolated Active interval, before easing through Day 3 (01 Apr).

Energetic Particles / Solar Radiation: High energy proton flux, as observed by GOES18, is expected to be near background levels, but with a slight chance of a further enhancement above the S1 level given any strong flares from AR3615. High energy electrons are likely to continue at Low to Moderate levels, with only a slight chance of reaching High. The associated 24 hour

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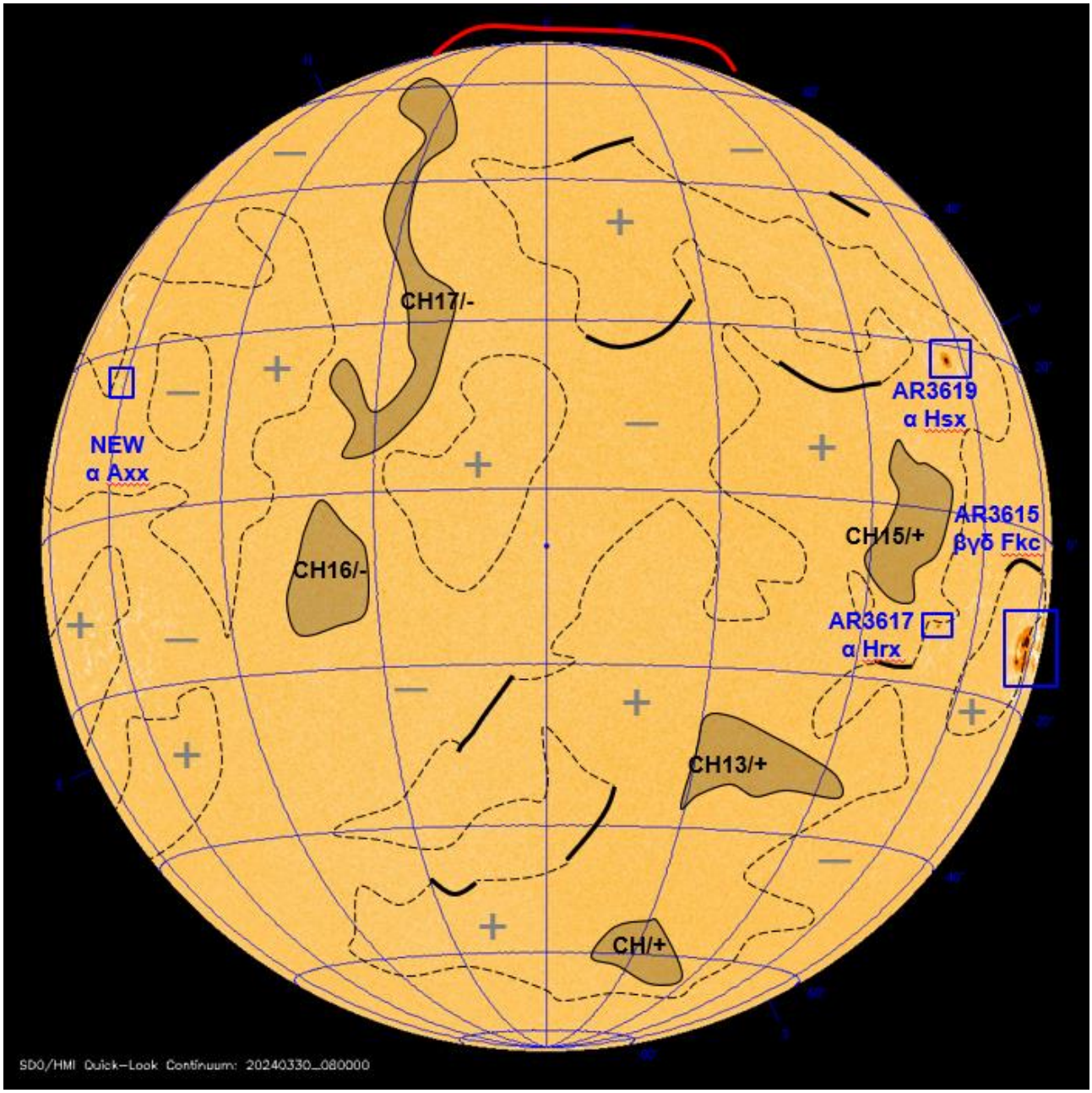
fluence may exhibit a slight increasing trend but is expected to remain well below the Active threshold.

Figure 1. Solar Analysis Valid 30/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

At present, there are no Earth-directed CMEs expected during the forecast period.
The current slow wind conditions are expected to slowly increase later Day 1 into Day 2 (30-31 Mar) due to the arrival of a fast wind associated with CH15/+ or CH13/+. These are small, non-recurrent features and are not favoured for a geomagnetic response at this time of year due to their positive polarity. As such, only a limited enhancement is expected which is supported by MOSWOC Enlil's output. Wind speeds are likely to ease later in the period.

Geomagnetic activity is expected to be mainly Quiet, but with the chance of Unsettled intervals Days 1-2, perhaps with an isolated Active interval, before easing through Day 3 (01 Apr).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No Earth directed CMEs are currently expected.

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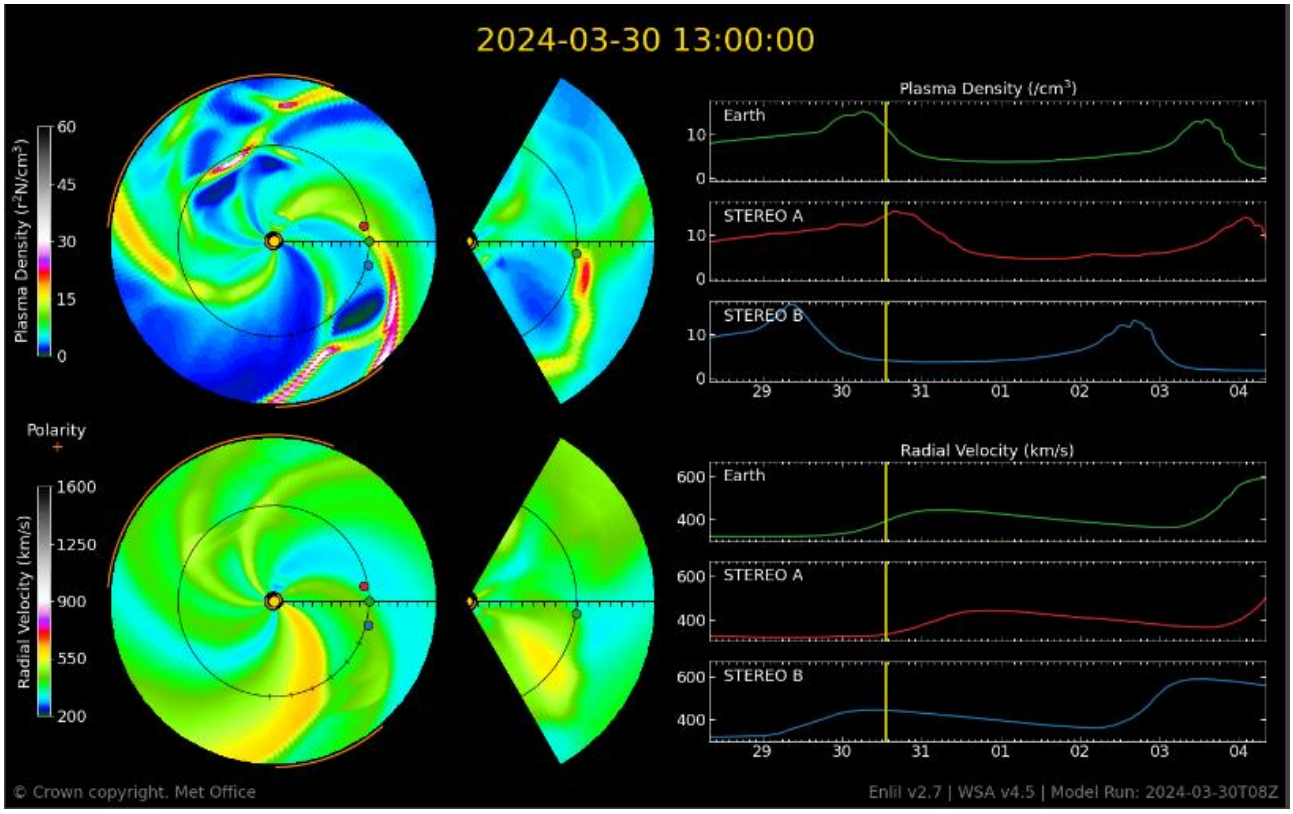
Figure 2: MOSWOC Enlil showing a slight rise in wind speeds today, due to CH15, which seems reasonable. A stronger increase is possible after the end of the current four day forecast period.



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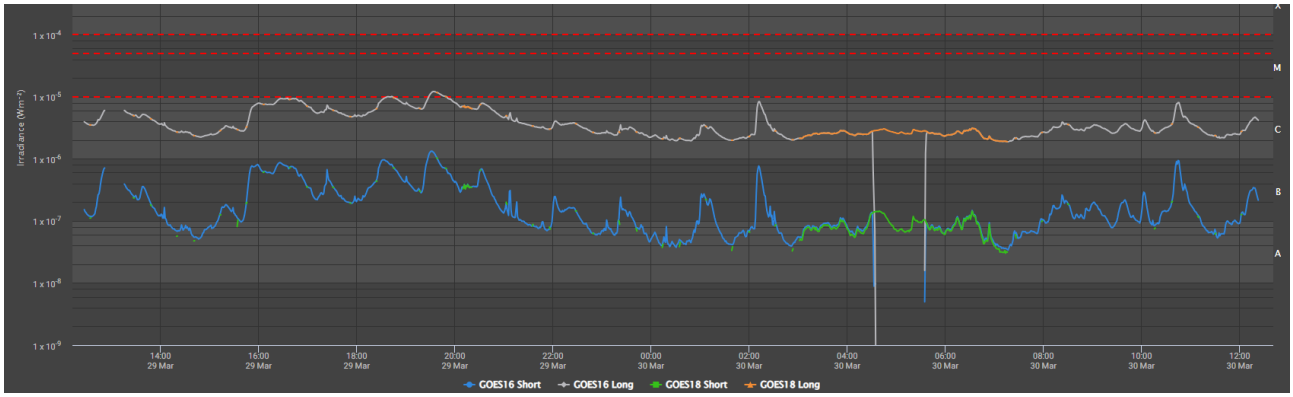
Radio Blackouts - X-Ray Flares:
Moderate activity is expected Day 1 (30 Mar), with a chance of an isolated X-flare from AR3615 as it continues to rotate off the southwest limb. There is a very slight chance of an X10+ flare (R4 Blackout). Confidence decreases on Day 2 (31 Mar) as the region rotates away over the limb, but still with a risk of any large flares being observable. Activity is then expected to be Low by Day 3 (01 Apr).

AR3615 (Fkc/Beta-Gamma-Delta) dominates the flare forecast, remaining a very large and relatively complex sunspot group. Due to the restricted viewing angle of the group as it approaches the western limb, the previous analysis has been retained, but at least one delta spot remains evident. The other spots are all small and simple unipolar regions, unlikely to be sources of notable flare activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	60	30	20
Very Active	R3 to R5 X Class	No	30	20	5	1

Figure 3: X-ray flux at GOES16 and 18, showing a couple of low level M-class flares.



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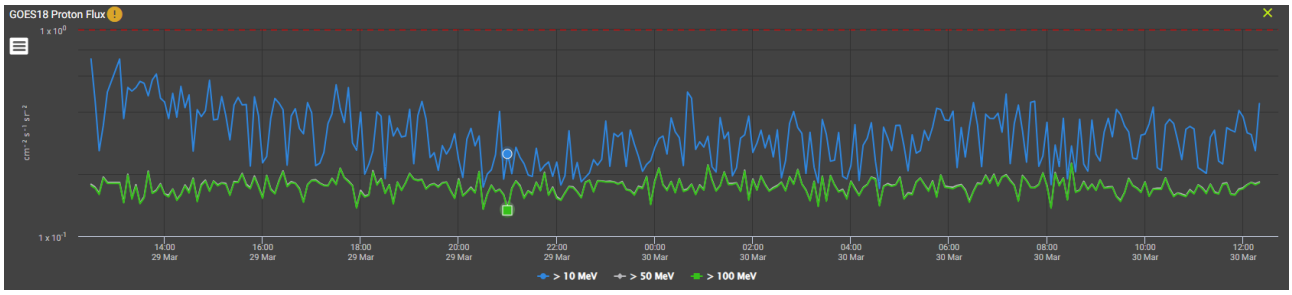
Solar Radiation Storms - (High Energy Protons):
High energy proton flux observed by GOES-18 is now near background levels again after the S2 Moderate Radiation storm that peaked 24 Mar. Further large flares from the departing AR3615, especially more intense or longer duration ones, could still be eruptive and proton rich. The associated risk of proton events is maintained until the region has rotated fully beyond the west limb, declining by Day 4 (02 Apr).

There is a slight chance of reaching the S1/Minor Radiation Storm threshold, given any further significant flaring from this region.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	5
Very Active	**≥ S3 ***	No	5	5	5	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton flux at GOES18, with 10MeV protons now near to background levels after the recent enhancement.



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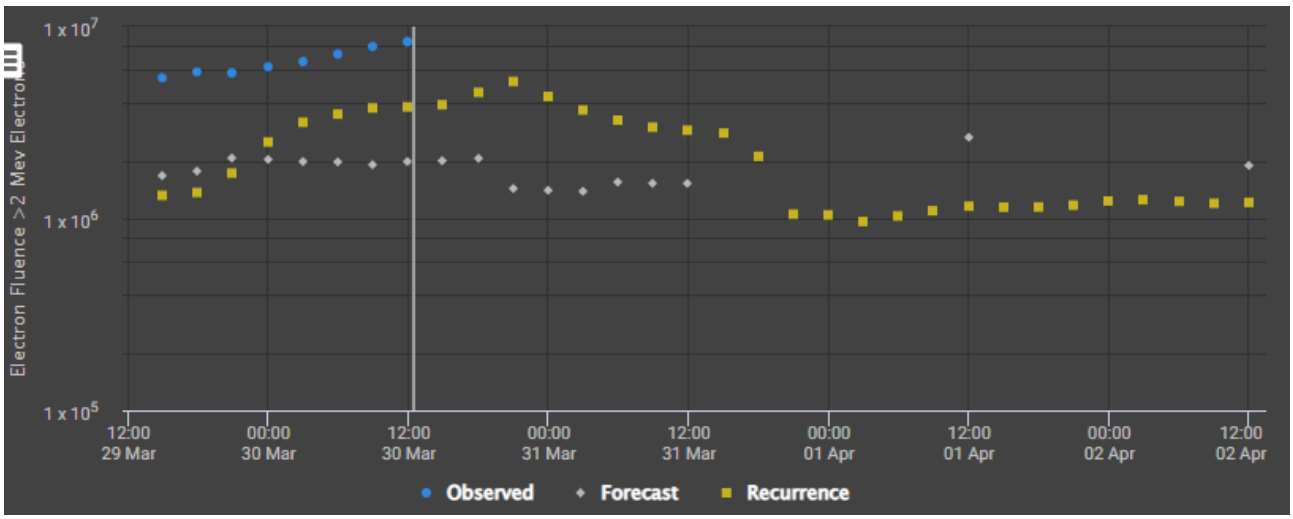
High Energy Electrons Event (≥ 2MeV):
High energy electron flux as observed by GOES-16 at GEO, has been just about reaching Moderate levels during the last 24 hours. This is despite the CME arrival last Sunday (24 Mar), which likely enhanced electron counts at lower orbitals. Although any associated enhancement at GEO now seems unlikely, there remains a chance of count rates giving brief periods of Moderate to High flux. Any fast wind connection to coronal holes CH15/+ and CH13/+ is expected to be minimal, and is not expected to increase the risk of prolonged High flux levels.

The associated 24 hour electron fluence is expected to remain well below the Active level, although a slight rising trend is possible during the period. Although fluence levels are currently above REFM forecast levels, REFM which is still considered to be giving good guidance for the trend of fluence values.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: MOSWOC REFM showing a below Active forecast.



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